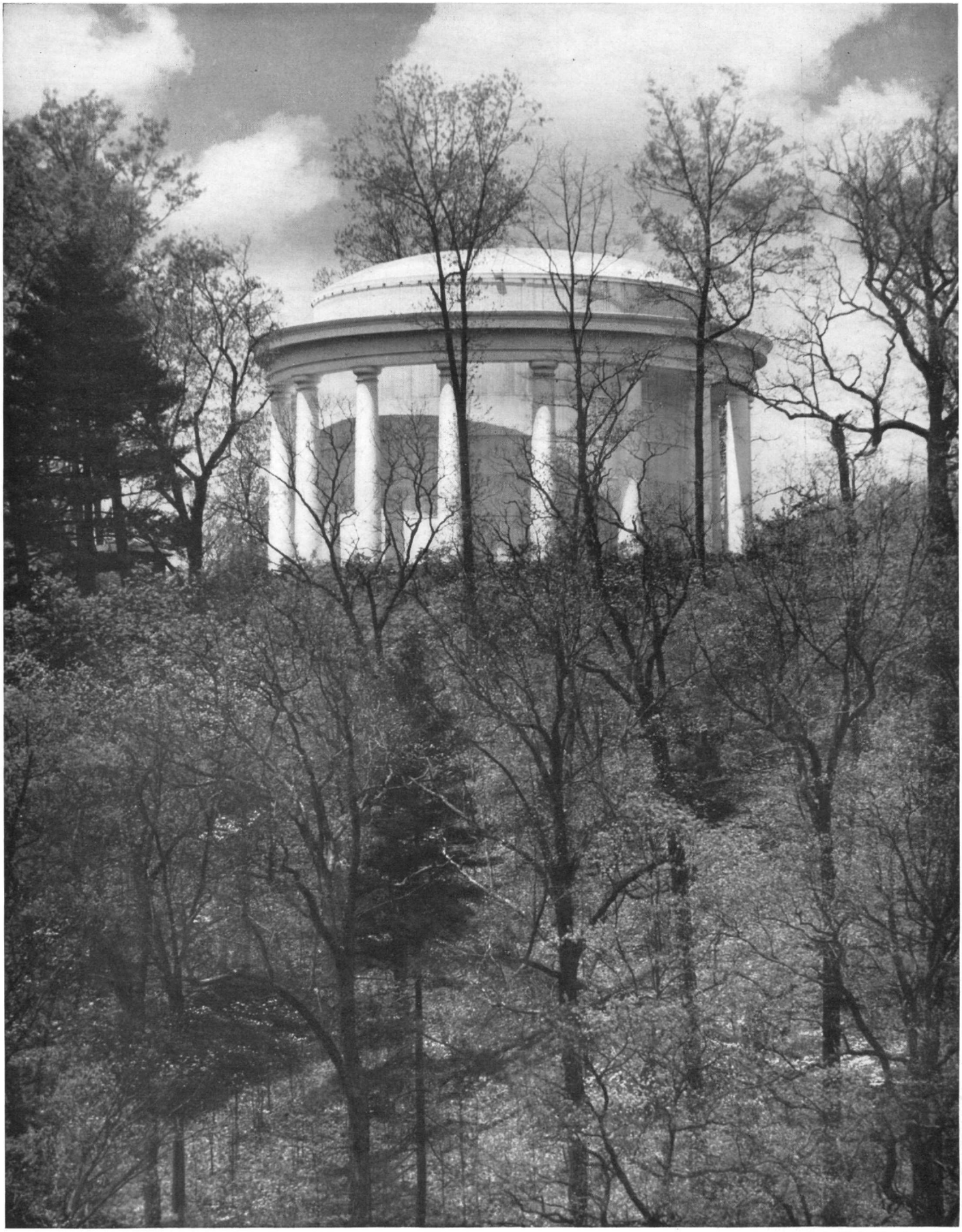


—Courtesy of Civil Engineering.

BEAUTY IN ENGINEERING

By PERRY BORCHERS

"BEAUTY in engineering?" the average student may ask, "Why, engineering isn't beautiful; it's too practical to be beautiful." A little observation, however will show that beauty is becoming an important factor in engineering. The longer one studies engineering, the more apparent it becomes that very little in this world does not affect the engineer and the quality of his work. A knowledge of economics, sociology, and languages are a few subjects which promote the efficiency and improve the results of the engineer's work; and the current trend toward esthetic beauty in engineering structures indicates that some knowledge of how to achieve beauty in design may in time become an important part of many branches of engineering training.

After all, beauty and engineering are not incongruous expressions. The first engineers were structural engineers. The pyramids and temples of Egypt are their first monuments.

The Romans were magnificent engineers, but their great baths, temples, aqueducts, and amphitheatres such as the Coliseum, are praised as much for their beauty and impressiveness as for the remarkable structural engineering which have kept many of these buildings standing today.

The great Gothic cathedrals of about the fourteenth century were beautiful in their slender proportions and wonderful decoration, but it was only the fine knowledge of engineering and mechanics which sustained the delicate vaults, pinnacles and buttresses. Again, the men who designed these great cathedrals were men who had both engineering knowledge and a sense of esthetic beauty.

Sir Christopher Wren, the famed English designer of St. Paul's Cathedral, and Perronet, the great French designer of bridges, were men of fine engineering knowledge, but their structures are also famous as things of beauty.

The engineer has a deep background and a long heritage of practical construction combined with esthetic beauty of design.

"But wait," someone may say, "I've heard of Sir Christopher Wren and Perronet spoken of as architects, and histories of architecture talk of the pyramids and the Roman buildings as being architecture, not engineering. So they who built those beautiful buildings really weren't engineers, but architects."

This is not hard to answer. Before 1800, the engineer and the architect were the same man, who was often called the "master-builder." After 1800, the professions of architecture and engineering began to draw apart.

Perhaps this drawing apart accounts for the general lack of beauty in what is known as the Mid-Victorian Era, when engineering structures were designed by the engineer for use only, without due attention to good proportions. If they felt a need for "prettying-up," an architect was called in to plaster on a few Roman columns and mouldings and other decorations which usually left the structure looking worse than before.

What has all of this long digression proved? History seems to show that an engineering mind can have, and often has had, a feeling for esthetic beauty. It would also seem to indicate that the best results are obtained when the structural designer and the man who designs for beauty of effect are one and the same person.

So far we have concerned ourselves chiefly with the structural engineer. The new branches of engineering such as electrical, chemical, mechanical and metallurgical engineering, which arrived during the last century do not have a tradition of beauty behind them. Still it must be remembered that these engineering fields use beauty of design in such things as machines and tools for home use, such as lawn mowers and kitchen equipment, pleasant interiors for factory work, electrical fixtures and other articles.

During the past few years there has been a revival of engineering interest in making structures beautiful as well as useful and economical. The magazine, *Civil Engineering,* published by the American Society of Civil Engineers, has devoted many articles to art in engineering. The American Institute of Steel Construction has been awarding prizes for the most beautiful steel bridge built each year. Great attention is being given to changing prominent water towers from "eye sores" into things of beauty. And the results in many cases are beautiful.

The frontispiece is of a recently-built water tower at White Sulphur Springs, West Virginia. Designed by a civil engineer, it is 60 feet in diameter, 48 feet high, and is encircled by columns not attached to the tank. The whole structure has a temple-like appearance which fits in very well with its woodland surroundings.

A more common design is to encase the tank itself, leaving space in the top suggesting a belfry. Some of these buildings seem to be bell towers, not water tanks.

This deceptive appearance is a point that draws much criticism. Many designers claim that it is not honest, true beauty, if a structure appears to be what it is not. The structure may appear beautiful at first,

but it loses this beauty when it becomes apparent it is only a sham, and has no real function.

A water tower design which may be much more praiseworthy is one at Towson, Maryland. The steel supports rise vertically from the ground and wrap around the tank many feet above as ribs meeting at a point on the top. The effect is somewhat of a bullet pointed skyward. It's use is at once apparent. It is slim and well proportioned and its gleaming metal parts make it very modern and very sleek.

Bridges are probably the best illustration of beauty in design. A very pleasing bridge near Columbus is the one over the Scioto at Dublin.

This bridge was built of concrete faced with limestone. Care was taken in determining the most pleasing sizes and colors of the stone. Limits in face heights and of cut areas were specified. Variations in color of stone were obtained by laying some of the stones with their natural bedding planes exposed. These stones have a wide range of tan and brown color due to vegetable and mineral stains. The trim stones on the piers and the cap stones on the railing were bush-hammered to definite planes to give the bridge a more finished appearance.

The stone fits in well with the surroundings as there are many outcroppings of limestone along the banks of the river. The stone is not only decorative, but acts as protection to the concrete. Overhanging balconies and vertical wall recesses add a bit of ornamentation and break up the flatness of the large wall areas by casting shadows over the surface of the stone. The arches increase in span at the center, and thus escape from a stiff mechanical feeling which might have been the case had all the arches been identical.

Of many beautiful bridges this is probably the most easily visited from Columbus.

This bridge illustrates some of the conditions necessary for beautiful design. The materials should be appropriate to the setting, sketches should be used to determine the best proportions and careful attention should be paid to optical illusions. The concealing of unwieldy joints and careful designing of struts and bracing are important in trusses.

A favorite type of bridge in recent years is the deck type structure, with a clear view of the sky, and low railings on either side. Compare these bridges with the ones of twenty years ago, narrow, with heavy truss members, and "rattley" wood planking on the floor. Certainly the new bridges are much more beautiful than the old.

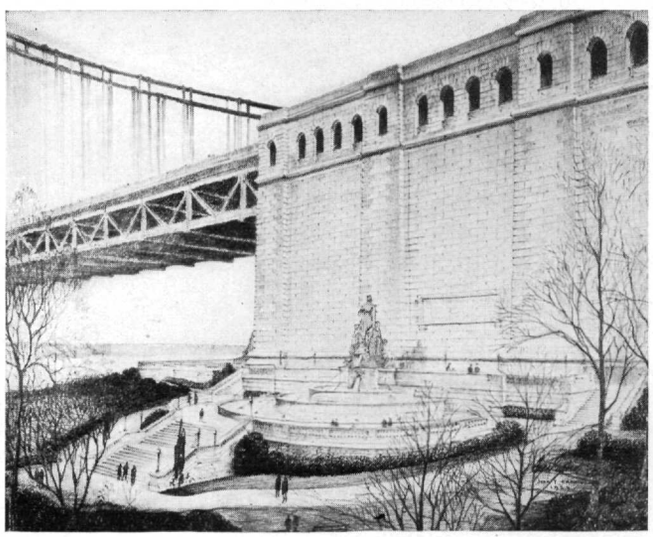
A very interesting article on bridge design by Aymar Empury appeared in a recent issue of *Civil Engineering*. The article concerns the design of the anchorages of the George Washington suspension bridge in New York City.

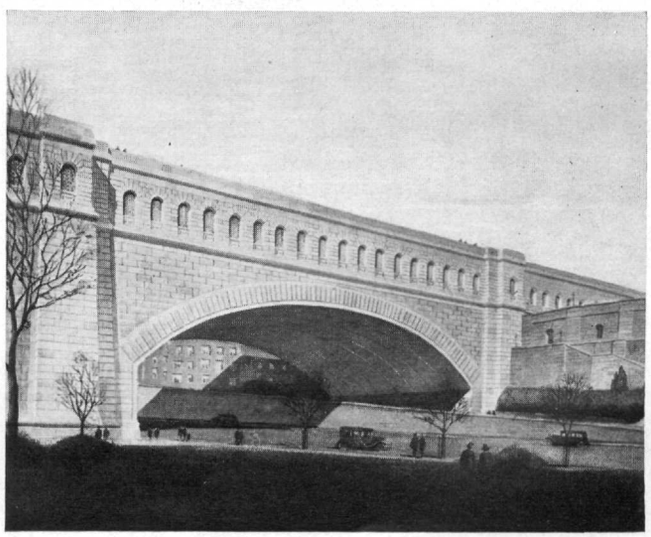
The anchorage should be a solid weight. It must hold the cables and also appear completely capable of holding them. It should have no doors or windows. The stone joints and arcaded openings in the original design suggested construction of a hollow building, not of a solid mass to hold the cables. There is also a clash of styles if anchorages and piers of classical design, with columns, pilasters, and mouldings, are set next to great modern, steel structures.

The new anchorage design is planned to express the bend of the cables around the rocker arms and the pull of the cables against the concrete. The forward sides of the concrete are tilted almost perpendicular to the pull of the cables. The broad, smooth, undecorated surfaces of the concrete suggest a heavy, solid mass, perfectly capable of performing its function of holding the cables.

In closing, what general advice can an engineer take in trying to produce more beautiful structures?

Original Design of Anchorages and Approaches for George Washington Bridge





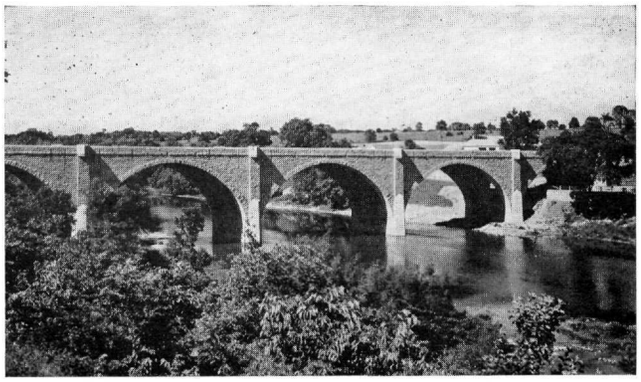
—Courtesy of Civil Engineering.

First, structural designs can not be completed and then esthetics applied like a coat of paint. Plastering a structure with ornament and concealing its function for supposed esthetic reasons, covering the surface with columns, mouldings, and arches which perform no function, often result in buildings that can be described only as atrocious.

It has been frequently stated that a clean, well thought-out, well-braced, engineering structure, though it may not be beautiful, can never be downright ugly.

It might help the engineer to learn the architectural approach to a problem. The engineer usually attacks a problem with diagrams and tables of weights; the architect begins with sketches in perspective. Since there are many ways of arranging supports and braces to satisfy requirements, a little preliminary sketching should determine which of these ways is most beautiful in appearance.

Free hand sketch studies are more valuable than sketches by instruments. It has been wondered how many times 30, 45, and 60-degree slopes have been used for diagonal members only because these slopes are the ones used on drafting triangles. Probably some other slope would have seemed much more graceful and less mechanical.



—*Courtesy of Civil Engineering.*
Dublin Bridge Over Scioto

Engineering is devoted to the practical solution of the human problems of safety, ease, comfort and convenience. The adding of beauty is truly worth while.